
Network neutrality and foreclosing market exchange

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Abstract: We analyse the effects of ‘network neutrality’ proposals that seek to foreclose or severely limit market transactions. Our model reveals that rules that prohibit efficient commercial transactions between content and broadband service providers could be bad for all participants – consumers would pay higher prices, the profits of the broadband service provider would decline, and the sales of internet content providers would also decline. Moreover by shifting costs to consumers that are more efficiently borne in the exchange between content and broadband providers, such rules may shift sales from content providers to the broadband provider’s content affiliate.

Keywords: network neutrality; regulation; internet; broadband providers.

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1 Introduction

New applications, in particular streaming video, are creating a rapid and explosive growth in the bandwidth demands on the internet, and ensuring that firms build, operate and maintain adequate internet infrastructure to meet this growth is perhaps the central challenge of telecommunications policy today (Swanson, 2007; Kerpen, 2007). Since, in the USA, local broadband networks and the internet backbones are built, operated and maintained by the private sector, satisfying the growing demands of consumers is the responsibility of broadband and content firms. And, like any other private enterprise, decisions about allocating resources to these endeavours is largely left to market forces, the essence of which is the pricing mechanism. Reliance on market forces for the development of the internet was the result of a conscious decision by policymakers in the early 1990s when the internet was privatised: policymakers knew that commercial demands upon the internet would flood the largely publicly financed and procured internet backbone, and these policymakers decided to entrust network infrastructure decisions and, importantly, network access pricing and peering policies, to the free market (MacKie-Mason and Varian, 1995). As a result, network operators, content providers, and consumers are, today, free to contract with one another over the price, terms and quality of the services they obtain and provide over the internet.

But now many policymakers and commentators, under the moniker of ‘network neutrality’, seek to regulate some commercial interactions for internet services. Some such rules aim to purposefully and severely limit the scope of market transactions for internet services and foreclose others altogether. For example, the Internet Freedom Preservation Act introduced in the 110th Congress would prohibit broadband service providers from charging internet content and application providers for specialised bandwidth prioritisation services that might be necessary to provide high-quality video or voice multimedia applications to consumers.¹ In this proposed legislation, a broadband service provider could only charge its consumers directly for these types of network improvements, and even then only through tiers of “defined levels of bandwidth” or rates that reflect only “the actual quantity of data flow over a user’s connection”. This legislative proposal would virtually eliminate the flexibility of content providers,

broadband service providers, and consumers to enter into voluntary, welfare-enhancing agreements that are prevalent in other areas of the communications industry.

In this paper, we explore the potential impact of imposing this type of regulatory structure on the internet on content providers, broadband service providers and consumers. We show that, to the extent that these proposals alter the behaviour of firms and consumers (as they are intended to do), network and service enhancements by a broadband service provider suitable to support particular internet content and applications would become even more costly. Our analysis borrows concepts from the field of transaction cost economics and two-sided markets to demonstrate the impact that such a policy would have on the pricing of internet content and broadband services. We show that, under simple and plausible conditions, prohibiting commercial transactions between content and broadband service providers could be bad for all participants: consumers would pay higher prices, the profits of the broadband service provider would decline, and the sales of internet content providers (like Google and Amazon.com) would also decline. In fact, rules that prohibit the market from contracting efficiently may shift sales from content providers to the broadband provider's content affiliate, a result entirely inconsistent with the stated desire of network neutrality proponents. While proponents of such rules may view them as protection from anticompetitive behaviour by broadband service providers, such proposals also eliminate the potential for efficient, voluntary, welfare-improving market transactions.

We stress that this paper is neither a general treatment nor condemnation of network neutrality regulation. Network neutrality is a broad and dynamic concept, so a general treatment is precluded. But, presumably, the purpose of internet regulation is to improve – not to reduce – economic performance. Nevertheless, regulation often has unintended consequences, and the role of this paper is to reveal the potential defects of an outright prohibition on market exchange.

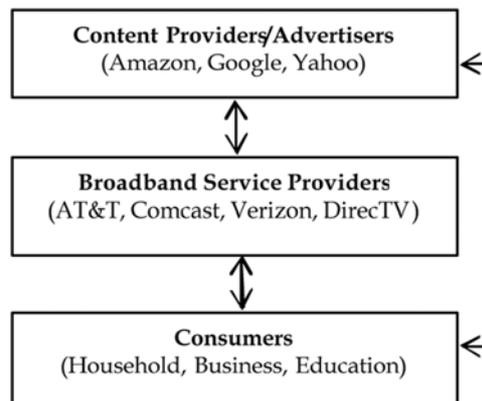
2 Conceptual analysis

The internet is often described as a 'layered' network – content providers stand at the 'top' and consumers at the 'bottom', while networks are poised in the 'middle', serving as the intermediary, conduit, or platform through which content is provided to consumers. Like any other private sector endeavour, neither the content provider nor the broadband network firm offers its services for free – both classes of firms seek to earn a profit via prices for the services they offer. As exhibited in Figure 1, in this stylised construction, many different market transactions might take place; between the consumer and the broadband network provider, between the consumer and content provider, between the content provider and the broadband network, between consumers and consumers and so forth.

While services generally flow from the 'top' of the figure to consumers at the bottom, dollars do not necessarily flow from the 'bottom' straight to the 'top'.² Payments for services rendered can be made in a variety of ways. Consumers purchase broadband access, and in some cases related services (virus protection, website hosting and so forth), from broadband service providers. Consumers also purchase services from content providers including subscription services, banking services, books, medicines, and nearly any other product or service imaginable. At the same time, for many content firms, the internet is their major means of delivering product to their customers. Through services

like auction sites and classifieds, thousands of consumer-to-consumer transactions occur daily. As a result, content providers routinely purchase services from internet backbone service providers, including interconnection and transit services.

Figure 1 Transactions in the layered internet



From the perspective of economic theory, much can be learned about the past, present, and future nature of these transactions from concepts like transaction cost economics and the relatively new theory of two-sided markets. Transaction cost economics was developed largely to explain why and when particular types of market exchange would predominate in different industries. A core hypothesis of transaction cost economics is that firms will individually and collectively seek out relationships that on the whole minimise transaction costs (in an effort to maximise profits) (Coase, 1937; Williamson, 1985). Transaction cost economics plays an important role in modern economic policy. As observed by Mayo and Kaserman,

“The basic insight [of transaction cost economics] that observed firm behaviour can often be explained in terms of attempts to reduce the costs of conducting market exchange has been an important factor in improving our public policy toward business over the past two decades, particularly in the field of antitrust. Market activities that were previously viewed with considerable suspicion or even outright hostility (for example, vertical integration, tying arrangements, and territorial restrictions) have gradually come to receive more hospitable treatment as our understanding of the efficiency motives behind these activities has improved. Allowing firms to pursue actions that reduce costs (whether they are costs of producing products or costs of conducting exchange) enhances overall economic performance.” (Mayo and Kaserman, 1995, p.28)

Transaction cost economics can be used to explain a variety of phenomena, from the organisation of firms, to the way contracts are written, to the way goods and services are priced.

Multi-sided markets theory explores the industry structure and pricing behaviour in markets in which particular ‘platforms’ have different sets of consumers that wish to engage in transactions. In multi-sided markets theory, the value of a platform depends on the number of participants on both sides of the platform. The primary contribution of the theory thus far is to point out the sometimes complex pricing problems faced by intermediaries attempting to gather participants on both sides of the platform (Rochet and Tirole, 2003, 2006; Armstrong, 2006; Hagiu, 2006; Evans, 2002).

From a policy perspective, the key insight of multi-sided market analysis is that pricing schemes in these 'platform' industries can be highly complicated and even surprising, and that many traditional ways of thinking about pricing (in a one-sided context) are misleading (Wright, 2004). The pricing schemes used to recover the costs of building and operating a 'platform', such as broadband service, may include prices to some or all sets of customers of the platform (Hahn and Wallsten, 2006). The economics of such multi-sided markets indicates that common notions of equity or fairness might actually be inefficient and costly to maintain. For example, in multi-sided markets, optimal individual price components may not be cost-based, below-cost pricing need not be predatory, and competition does not necessarily force prices to cost.

Because network neutrality rules essentially seek to regulate these vertical commercial relationships between content firms and broadband providers, it is important to examine how those rules would impact the ultimate provision of goods and services at each level (or 'side') of the industry. Particularly important to the network neutrality debate is the fact that a high price on one side of the market generally requires a low price on the other side, since attracting members to the other side becomes more profitable. Thus, a positive price to content may facilitate a reduction in price to consumers, thereby increasing broadband subscription. Put very simply, if a content or broadband provider's advertising price is a function of its number of subscribers, then it may make sense to lower the price to subscribers to attract more of them.

Many proposals to regulate the internet actually attempt to effectively foreclose potentially efficiency-enhancing market transactions – i.e., those between the content provider and broadband service provider.³ By preventing market exchanges between these two entities, policymakers would effectively force the broadband service provider to charge only consumers for the services it provides, even if those transactions are far more costly than transactions between content and network providers. Effectively barring one form of market exchange between content providers and broadband service providers is not dissimilar to prohibiting cable television operators from accepting payments from content providers or advertisers, as doing so would no doubt lead to higher consumer cable rates, less content, and presumably less-efficient industry structure.

One can understand how such rules would increase transactions costs if one considers the impact they might have if applied to another industry, such as the sale of books by online retailer Amazon.com. As discussed above, because firms and consumers will act in order to minimise transaction costs, certain ancillary yet important services (like shipping a book from Amazon.com via UPS) are often bundled with the sale of a final product because it is more efficient for those services to be procured by the firm selling the product rather than obtained individually by the consumer. While the average consumer may make a handful of online purchases a month, Amazon.com has warehouses with pre-existing bulk shipping arrangements with shippers like the US Postal Service or UPS because it ships thousands of packages a day. Society is better off because when Amazon.com offers its customers shipping, it is far more efficient for Amazon.com to bundle shipping with its book sales than to force consumers to contract directly for shipping with the Post Office or UPS for each purchase. It is also economically desirable for Amazon.com to offer more than simply the most basic parcel post shipping option itself, rather than force customers to coordinate outside shipping arrangements between shipping firms and Amazon.com if 'next day' shipment is desired. Similarly, a firm that is in the business of streaming video to consumers is likely to be in a far better position to understand, plan for and ultimately procure special broadband

network services necessary to deliver a video programme to a consumer, who simply may want to push a button on a remote control and watch a baseball game.

One can begin to see similar types of arrangements emerging for bandwidth-intensive internet applications like streaming video (though not in the way most content providers fear). Most notably, ESPN is offering its online video 'ESPN360' product only to customers of broadband service providers *who pay ESPN to distribute this content* (Nassauer, 2006). The popular social networking site Facebook has struck a deal with Comcast to make video 'Facebook Diaries' available on Comcast's Ziddio website and Comcast On-Demand customers (Reuters, 2007). Even firms with similar products are experimenting with different models of providing online broadband content. For example, Major League Baseball currently charges customers directly for online streaming of out-of-market baseball games, a service that costs \$89.95 for the full season, which also includes searchable video and condensed games. In contrast, the National Hockey League has an exclusive relationship with Comcast so that Comcast Hi-Speed customers can watch online streams of National Hockey League games for free (Reardon, 2005). These different models of delivering bandwidth-intensive content to subscribers may or may not be commercially sustainable, but it is clear that firms are experimenting with different business models.

In this environment, it is dangerous to assume that one particular method of delivering and paying for these services is the 'correct' one and foreclose all others. As we show below, foreclosing upstream content providers from directly contracting with broadband network firms to deliver their products could have an impact upon the price and availability of new online services and applications. If rules analogous to some 'network neutrality' proposals were imposed on Amazon.com's book sales, then the Postal Service, UPS, and other shippers would be prohibited from negotiating a bulk arrangement with Amazon.com. Instead, every customer who wanted to purchase a book from Amazon.com would need to contact a shipper separately to arrange for shipping.⁴ Seen in this light, it does not take long to understand how foreclosing or limiting content provider-broadband provider contracts could throw sand into the gears of online commerce.

In this paper, we consider the effect of these limitations on exchange by using a simple transaction cost framework. More specifically, we contemplate the role of transaction costs for a service provided by a broadband service provider that can be 'ordered' by either consumers or content providers, but where the transaction costs are not identical. In this setting, impeding commercial transactions on one side of the market could lead to undesirable outcomes both 'upstream' and 'downstream'. Even in the absence of transaction costs, however, overall economic efficiency and market performance could be negatively impacted by a rule that forecloses market exchange. While we focus on transaction cost economics here, we suspect that other theoretical treatments may provide additional insights outside the scope of our model.

3 Theoretical model

In the theoretical analysis that follows, we present an economic model which shows that imposing this type of arrangement on the internet could be bad for all participants under plausible circumstances; the profits of the broadband provider decline (and, consequently,

investment in the network), the sales of the content providers decline (and, given the cost structure of content, the number of providers) and consumers pay higher prices.

3.1 Basic setup

Our theoretical model has the following basic setup. We assume that the market consists of a sector of application and content providers (A), a broadband network provider (B) and a large number of consumers (N). For modelling convenience alone, we assume that there is a monopoly broadband service provider. While we recognise that this assumption is not an accurate reflection of the broadband market, we note that had we allowed for competition among broadband providers in our model our general findings would not be altered. We further assume that all customers of the content provided by sector A must buy broadband access (service X) from B at price P_X . Customers with broadband access can then purchase an additional service S (say, a sporting event in high-definition) from either A or B . Purchasing service S requires the broadband network provider B to modify its network in some way to accommodate the delivery of the service (such as traffic prioritisation or some other form of caching or dynamic bandwidth adjustment). This upgrade service is denoted with the letter Z .

Each of the services involved – broadband access (X), the content service (S) and the network upgrade needed to deliver the content to the consumer (Z) – have a cost, and those costs are represented in our model by C_X , C_S and C_Z . Because we are most interested in the impact of transaction costs on the equilibrium, we assume that the cost of the content service (C_S) is the same regardless of whether the service is provided by the upstream content provider A or the broadband firm B .

Finally, we represent the transaction cost that the consumer incurs in contacting either firm about acquiring service as t , and we assume that these costs are the same regardless as to whether the consumer must contact the broadband firm or the content firm. This assumption is not critical as long as entering into more contacts is, in general, more costly than administering fewer contacts.

On the demand side, there are three demand curves:

- the demand for access X
- the demand for service S sold by the broadband network firm B
- the demand for service S sold by the content firm A .

The demand for Z (the network upgrade) is purely derived from the demand for S (that is, each unit of S requires one unit of Z and Z has no utility value of itself). Demand, of course, depends on the full price of purchase, and the full price is the money price of the service plus the transaction cost. The relevant money prices for our analysis include:

P_X : Money price for service X purchased from firm B (broadband access)

P_S^A : Money price of service S purchased from a firm in content sector A

P_S^B : Money price of service S purchased from firm B

P_Z^A : Money price charged to sector A for upgrade Z^S

P_Z^N : Money price charged N for upgrade Z .

Initially, and for simplicity, assume that sector A sets the price for its service at marginal cost.⁶ We denote full prices (money price plus transaction costs) using the carat ('^') symbol, so that \hat{P}_S^A is the full price of service S from firm A . Service S cannot be purchased without service B . We assume, for simplicity, that $\hat{P}_X = P_X$ (this does not affect the analysis).

The three demand curves are

$$Q_X(\hat{P}_S^A, \hat{P}_S^B, P_X); \quad (1)$$

$$Q_S^A(\hat{P}_S^A, \hat{P}_S^B, P_X); \quad (2)$$

$$Q_S^B(\hat{P}_S^A, \hat{P}_S^B, P_X); \quad (3)$$

where we assume:

- higher broadband prices reduce all quantities sold ($\partial Q_i^f / \partial P_X < 0$) where f is either A or B and, since there are only two, then $-f$ represents 'not f '
- the demand curves for S slope downward ($\partial Q_S^f / \partial P_S^f < 0$)
- A and B are competitors ($\partial Q_S^f / \partial P_S^{-f} > 0$).

The demand Q_X depends on P_S because, while X itself provides services, someone who buys X will pay more for it when add-on services, such as S , are cheaper. These assumptions are not controversial.

3.2 Determination of full prices with and without net neutrality

In our analysis, we wish to evaluate the implications of a network neutrality rule that blocks direct exchange between the application and content provider A and the broadband provider B . Thus, if the consumer wants to purchase a movie (service S) from A that requires a network upgrade (Z), then the consumer must contact the broadband service provider B to request the necessary network upgrade Z . As described above, requiring the consumer to make two contacts to purchase S is an element of some internet regulatory proposals that foreclose content and broadband providers from voluntary contractual agreements. Without the network neutrality rule, the content firm A can contact B directly to arrange for this upgrade. We assume that $P_S^A = C_S$, plus any other cost that A incurs (e.g., P_Z^A in some cases), and that there is no transaction costs for A to contact B for the upgrade.⁷ On the other hand, under network neutrality regulation, the consumer incurs transaction cost t to contact B if the consumer wants to purchase S from A . An example of this type of transaction would be a consumer requiring a short-term bandwidth expansion in order to watch a particular sporting event in high definition format and in real time. Thus, the effect of network neutrality regulation is to impose an additional cost of t that no one collects from the customer who buys service S from A .

We assume in this analysis that the transaction cost of a consumer contacting the broadband provider exceeds that of the content provider contacting the broadband provider. In the absence of any internet regulations that preclude voluntary transactions on one side of the market, consumers, the broadband provider and content providers will engage in transactions that minimise transaction costs. As a result, the contract

foreclosure is only relevant to the extent it changes the patterns of behaviour. Prohibitions or limitations on particular transactions only matter when such transactions are more efficient. Our goal in this paper is to examine the impact this increase would have upon consumers, content providers, and broadband service providers, when an efficient transaction is precluded or limited by law on one side of a multi-sided market.

Without regulation, the full price of purchasing S from firm B , given X , is:

$$\hat{P}_S^B = P_Z^N + P_S^B + t \quad (4)$$

where the full price is the price of the upgrade Z , the price of the service S and the transaction cost of the order t . The full price to purchase from A is:

$$\hat{P}_S^A = P_S^A + t = C_S + P_Z^A + t. \quad (5)$$

In the presence of regulation, the full price of purchasing S from firm B is:

$$\hat{P}_S^B = P_Z^N + P_S^B + t \quad (6)$$

whereas the full price of purchasing from a firm in sector A is:

$$\hat{P}_S^A = P_S^A + P_Z^N + 2t = C_S + P_Z^N + 2t. \quad (7)$$

The difference between equations (5) and (7) is that two transactions are required by the consumer to purchase S when there is regulation.

There are many prices in our model, and solving for all the optimal prices would be tedious. Fortunately, since we are only interested in the effects of internet regulation, most of the effects of the regulation can be determined by evaluating the profit functions alone. Going forward, we assume that rather than choosing P_Z^N and P_S^B independently, let firm B just select P_Z^N and $P_S^B + P_Z^N$ (the latter being a ‘bundled’ price for S and Z). So, we define P_S^B as $P_S^B + P_Z^N$ henceforth.

Given the setup above, we can write the profit function with internet regulation (‘ R ’ for regulated) in terms of full prices as

$$\begin{aligned} \pi_R = & Q_X(\hat{P}_S^A, \hat{P}_S^B, P_X)(P_X - C_X) \\ & + Q_S^A(\hat{P}_S^A, \hat{P}_S^B, P_X)(\hat{P}_S^A - C_S - 2t - C_Z) \\ & + Q_S^B(\hat{P}_S^A, \hat{P}_S^B, P_X)(\hat{P}_S^B - C_S - t - C_Z) \end{aligned} \quad (8)$$

and without network neutrality regulation (‘ U ’ for unregulated) or

$$\begin{aligned} \pi_U = & Q_X(\hat{P}_S^A, \hat{P}_S^B, P_X)(P_X - C_X) \\ & + Q_S^A(\hat{P}_S^A, \hat{P}_S^B, P_X)(\hat{P}_S^A - C_S - t - C_Z) \\ & + Q_S^B(\hat{P}_S^A, \hat{P}_S^B, P_X)(\hat{P}_S^B - C_S - t - C_Z) \end{aligned} \quad (9)$$

where a symmetry with respect to P_Z^A and P_Z^N is apparent in equations (8) and (9), a consequence of the pricing behaviour of A .

Note that in equations (8) and (9) we defined \hat{P}_S^B as $P_S^B + P_Z^N$. Rewriting equations (8) and (9) in expanded form, we have

$$\begin{aligned}
\pi_R = & Q_X(C_S + P_Z^N + 2t, P_S^B + t, P_X)(P_X - C_X) \\
& + Q_S^A(C_S + P_Z^N + 2t, P_S^B + t, P_X)(P_Z^N - C_Z) \\
& + Q_S^B(C_S + P_Z^N + 2t, P_S^B + t, P_X)(P_S^B - C_S - C_Z)
\end{aligned} \tag{8'}$$

and without Internet regulation we have

$$\begin{aligned}
\pi_U = & Q_X(C_S + P_Z^A + t, P_S^B + t, P_X)(P_X - C_X) \\
& + Q_S^A(C_S + P_Z^A + t, P_S^B + t, P_X)(P_Z^A - C_Z) \\
& + Q_S^B(C_S + P_Z^A + t, P_S^B + t, P_X)(P_S^B - C_S - C_Z).
\end{aligned} \tag{9'}$$

These profit expressions reveal all the results needed for our evaluation of internet regulation of the type described here.

3.3 Theoretical results

The profit expressions above allow us to make some general statements about the effects of a prohibition on contractual arrangements between broadband and content providers. We are particularly interested in three effects:

- First, how would such a mandate affect the profit of the broadband provider? If profits are lower, then one would reasonably expect that investment into the broadband network business would shrink as a result of that mandate.
- Second, how would this mandate affect the overall price of the online service S to consumers? This question is important because increasing the price for the new online service over what it could have been in a world without regulation affects both consumers (obviously) and the health of the content service industry as a whole. If a network neutrality mandate decreases the profits of broadband providers and increases the price of online services, then everybody loses – the broadband network firms, the content providers and consumers.
- Third, we are interested in the price for broadband service itself. If prices rise, then broadband subscription will be lower than it would be without this type of internet regulation.

We do not consider in the model any alleged benefits of foreclosure. Such benefits might include, for instance, the removal of any prospect or potential for discriminatory or anticompetitive behaviour by the broadband service provider. However, we have not seen any cohesive or coherent model that estimates these benefits of foreclosing such transactions outside of unsupported assertions. As a result, while we do not rule out the possibility that the harms to efficiency that we discuss in this paper might be counterbalanced by these other benefits, policymakers should expect and demand a thorough accounting and quantification of those asserted benefits from internet regulation.

3.3.1 Broadband provider profits

Our first question involves the relative profits of the broadband provider B across the two regulatory regimes. From equations (8') and (9'), it is easy to show that internet regulation reduces the profits of firm B .

Theorem 1: *Firm B 's profits are larger without than with internet regulation ($\pi_U > \pi_R \forall \hat{P}_S^A, \hat{P}_S^B, P_X$).*

Proof: From equation (8') and (9'), we see that $\pi_U - \pi_R = t \cdot Q_S^A \geq 0$.

Thus, the model shows that internet regulation as conceived in this model reduces the profits of the broadband provider. As a consequence, we might expect less investment in broadband infrastructure with internet regulation of the type considered here, to the extent that regulation reduces the return on investments.

3.3.2 Impact on prices

Next, we turn to the question of full prices across regulatory regimes. Let $\hat{P}_{S,U}^A, \hat{P}_{S,U}^B$, and $P_{X,U}$ be the full prices in the unregulated environment and let $\hat{P}_{S,R}^A, \hat{P}_{S,R}^B$, and $P_{X,R}$ be the full prices with internet regulation. These prices will obviously differ, but the important issue is how they differ.

Theorem 2: *If π_U and π_R are globally concave, then*

$$\hat{P}_{S,U}^A < \hat{P}_{S,R}^A$$

$$\hat{P}_{S,U}^B > \hat{P}_{S,R}^B$$

$$P_{X,U} < P_{X,R}.$$

Proof: From equation (8') and (9'), we see that $\pi_R = \pi_U - t \cdot Q_S^A(\hat{P}_S^A, \hat{P}_S^B, P_X)$. At $\hat{P}_{S,R}^A$, we get

$$\frac{\partial \pi_R}{\partial \hat{P}_S^A} = \frac{\partial \pi_U}{\partial \hat{P}_S^A} - t \frac{\partial Q_S^A}{\partial \hat{P}_S^A} = 0,$$

implying

$$\frac{\partial \pi_U}{\partial \hat{P}_S^A} < 0 \text{ at } \hat{P}_{S,R}^A,$$

so that,

$$\hat{P}_{S,R}^A > \hat{P}_{S,U}^A.$$

Proofs for \hat{P}_S^B and \hat{P}_X follow the same logic.

3.3.3 Summary

We have the following results on prices: first, internet regulation (of the sort envisioned here) would increase the full price for service S sold by firm A . Thus, the online content providers A will sell less of these services. Advocates of network neutrality routinely argue that their proposals will increase the supply of online services and applications (Windhausen, 2006; Markey, 2006). This analysis shows that those arguments need not be correct; internet regulation of the type found in S. 215 could work against content providers and actually dampen demand for their services *when its effect is to impose a transaction cost on consumers*. Since the content providers typically face very high fixed costs relative to marginal costs, a reduction in sales will reduce the number of content generating firms (Ford et al., 2006). Second, internet regulation reduces the full price for service S sold by firm B , thereby transferring purchases from unaffiliated content providers to the access provider. Obviously, this result conflicts with the purported goals of this type of internet regulation and must be netted out of any alleged benefits of the regulation.

Finally, internet regulation of this sort may increase the full price of broadband access and, consequently, reduce the amount of broadband purchased.⁸ Importantly, this broadband access price increase will affect *all* broadband customers – not simply those that might be interested in purchasing new, bandwidth-intensive services. This impact is important because the consumption of broadband services declines as prices rise, so internet regulation that has the effect modelled here could decrease the overall penetration of broadband subscriptions in the USA. Based on available information, even a relatively small price increase of 5% would reduce subscription by about 5 million connections, reducing the rank of the USA from 15 to 17 among OECD countries.⁹ Therefore, while leading network neutrality proponents lament middling broadband subscription rate in the USA when compared to the rest of the world, a prohibition or limitation on contractual agreements between content and broadband providers that increases prices may exacerbate that condition.

3.3.4 Other considerations and caveats

There are a few additional comments to be made on our analysis. In our model, we assumed that the content market was competitive so that firms price their services at marginal/incremental cost. If the content market was imperfectly competitive – so that price exceeded marginal cost – then the broadband firm would have the usual incentive to vertically integrate to eliminate double marginalisation. This action would be beneficial to consumers, however, since the goal of the downstream firm's action in response to double marginalisation is to lower price in the upstream market (Mayo and Kaserman, 1995, pp.303–307). Thus, the incentive to favour an affiliated content provider is socially desirable in this case. Notably, we have not considered in this analysis other motivations to favour an upstream affiliate, such as the regulation of the broadband access price (P_X). We recognise that these incentives to vertically integrate are important to the debate.

We also have not modelled other potential impacts of implementing this particular network neutrality proposal. Most notably, the proposal would permit broadband network companies to have different priority classifications of services for content providers but would bar the network companies from charging for higher priority

services. This proposal creates an obvious ‘commons’ problem in which no rational content provider would ever seek any level of service other than the highest priority. Even apart from transaction cost implications, the impact of such a rule would appear to be deleterious to the efficient operation of an integrated, multi-service network (MacKie-Mason and Varian, 1995; Gross, 2007). Such transactions seem particularly likely to occur in mobile broadband applications, where content services may need to be customised for particular customer equipment, carriers, and service packages.

As is always the case, our findings are the consequence of the particular modelling assumptions of our analysis and we reiterate that our analysis is theoretical in nature. Our approach assumes that certain content services will require some modification to the broadband network to be provided with sufficient quality, and acquiring such modifications causes transaction costs. We provide no estimates of how large transaction costs may be and, in their presence, how much money and full prices change as a consequence of internet regulation. Such quantification is precluded, in our opinion, since the analysis could apply to a wide-range of services, most of which are speculative or unpredictable at this time. As the internet develops and newer, bandwidth intensive products are developed, it may be possible to quantify the likely consequences of regulations of this type.

Also, advocates of network neutrality frequently argue that it is important to limit the ability of a broadband provider to leverage market power into the content market. Yet, a network neutrality rule that requires all transactions related to broadband access and quality to be between the broadband provider and consumer (rather than between content and broadband providers) does not preclude this sort of exclusionary behaviour. Indeed, this particular form of regulation does not limit the ability of a broadband provider to exclude *A* by setting a high price for the upgrade and a low price for the service (though there is no incentive to do so under the assumptions of our model since the upstream is competitive). As a result, it is somewhat unclear what potential benefits derive from the regulation to offset the costs revealed here.

Finally, this analysis is but one element of a portfolio of evidence on internet regulations. We encourage contributors to the debate and policymakers to consider all analytical research on the need for and implications of internet regulation. As we have mentioned, the negative consequences of such regulation exposed here are (potentially significant) offsets to any alleged benefits of the regulation, perhaps making the regulation inconsistent with improvements in economic welfare.

4 Conclusions

In this paper, we have presented a theoretical analysis of the effects of certain network neutrality proposals that would effectively bar, limit or prohibit market exchanges between upstream content and downstream broadband providers. Our model reveals that this form of internet regulation is far from ‘neutral’ and could instead be undesirable in that it reduces the profits (and presumably the investment) of broadband providers, reduces the output of competitive content providers (and, presumably their numbers), and raises prices for consumers. The reduced output of the content providers is, in part, explained by the transfer of content sales from unaffiliated content providers to the broadband provider’s content affiliate, in conflict with one purported goal of internet regulation.

Over a decade ago, the US government released the internet to private industry with very few strings attached. Policymakers did not implement price controls or universal service mandates or dictate the terms and conditions of the myriad number of commercial relationships between consumers, content providers, software firms, advertisers, applications providers and network operators. Commercial relationships between all of these actors follow the same rules that the rest of the free market economy operates by – i.e., firms seek to maximise profits and minimise transaction costs and scarce resources are allocated by use of the price mechanism.

While proponents of internet regulation often claim that they are simply attempting to maintain the status quo, their proposals would instead outlaw an entire category of commercial transactions between content providers and network providers that have characterised the internet since its inception. In 1995, MacKie-Mason and Varian wrote that

“Internet transport is *already* priced, though many users seem unaware of that ... The reasonable question is not whether the internet should be priced at all, but what type of pricing should be used.” (MacKie-Mason and Varian, 1995)

Preventing network providers from charging content and application providers for prioritisation or other quality of service network upgrades would effectively place the costs of those network upgrades upon consumers that want services that use those upgrades. Requiring consumers to enter into two contracts – one for the content and one for the network upgrade could increase transaction costs substantially and serve to increase the price of both broadband services and the price of content and applications.

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Notes

¹Internet Freedom Preservation Act, S. 215, 110th Cong. (2007).

²We include advertisers in the group of content providers because, to a consumer, advertising is essentially content on a web page or service that subsidises the provision of other content to consumers. Consumers pay for this content with their eyeballs.

³Internet Freedom Preservation Act, S. 215, 110th Cong. (2007). Similar legislation was proposed in the 109th Congress. See Internet Freedom Preservation Act, S. 2917, 109th Cong., Section 2 (2006); Network Neutrality Act of 1996, H.R. 5273, 109th Cong. Section 4(a)(6), (a)(7) (prohibiting 'surcharges' based on content and prohibiting any "surcharge or other consideration" for "prioritisation or quality of service"); Internet Non-Discrimination Act of 2006, S. 2360, Section 4(a)(3) (prohibiting broadband service operator from "access[ing] a charge to any application or service provider not on the network of such operator for the delivery of traffic to any subscriber to the network of such operator").

⁴This option may allow the consumer to pick which shipper it prefers, rather than use the shipper chosen by Amazon.com, but few would argue that prohibiting Amazon.com from arranging its own shipping services (and thus obtaining better prices) is good policy. Indeed, Amazon.com currently subsidises shipping to its customers – in 2005, it spent \$239 million more on shipping its products than it charged consumers for that service, approximately 2.8% of its net sales. Amazon.com, Inc., SEC Form 10-K (17 February, 2006) at 35.

⁵This price is then passed through to their customers on a 1 : 1 basis, since the upstream is competitive.

⁶We discuss the impact of relaxing this assumption (by allowing a markup) later in the text.

⁷Alternately, we could normalise the transaction cost for A contacting B to zero, but the notation is simplified by our choice. This assumption has no meaningful effect on the results as long as transactions costs for N are greater than those for A .

⁸In general, if t rises, then P_X falls, but the total effect is a higher full price. Proof is available upon request.

⁹According to December 2007 OECD data, the USA has 69.5 million broadband subscriptions. Econometric studies estimate the own-price demand elasticity for broadband service in the USA to be about -1.5 . Thus, a 5% increase in the full price of broadband service will reduce the number of connections by about 5 million (assuming constant elasticity of demand). Elasticity estimates provided by Rappoport et al. (2002), Crandall et al. (2002), Goolsbee (2000) and Varian (2003). The 5% difference is chosen somewhat arbitrarily, but the effect of alternative price increases is easily computed.